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NOTES ON GEOGRAPHIC DISTRIBUTION

New distributional records of amphibians for Departamento San Pedro, Paraguay (Amphibia)

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ABSTRACT: New distributional data are provided for 12 species of amphibian in Departamento San Pedro, Paraguay. Records are from the Reserva Natural Laguna Blanca, a small private reserve located in an area of transition from Atlantic Forest to Cerrado-type habitats. The chronic under-sampling of amphibian populations in Paraguay is highlighted.

The first modern review of the taxonomy and distribution of amphibians in Paraguay was provided by Brusquetti and Lavilla (2006). They reported 81 species as present in Paraguay (including subspecies later raised to species level by Narvaes and Rodrigues 2009) together with a distribution table of species by political department (Table 1). Long term sampling bias may be inferred from the departmental lists, with a minimum of 18 species (22.2% of the total listed) recorded in Departamento Guairá, compared with a maximum of 44 species (54.3% of the total listed) reported for Departamentos Concepción and Presidente Hayes. With 25 species recorded (30.9% of the national total) Departamento San Pedro was ranked as the 11th most species-rich of the 17 Paraguayan Departments.

This national base list was refined by Lavilla and Brusquetti (2010) who included two additional species (Brusquetti *et al.* 2007, Airaldi *et al.* 2009) and made other taxonomic changes updating the national total to 83 species. On a local level, the results of sampling in the intervening years are scarcely visible and the updated departmental species totals show little difference from the numbers cited four years earlier (Table 1). With the removal of *Melanophryniscus* sp. by Lavilla and Brusquetti (2010), the Departamento San Pedro total actually decreased from 25 to 24 (28.9% of the national list).

In this paper we provide details of new departmental records of 12 amphibian species from the newly declared Reserva Natural de Laguna Blanca (RNLB) in Departamento San Pedro.

The RNLB is located in the Cerrado zone of northeastern Paraguay (23°48'45.4" S, 56°17'41.7" W). It is an 804 hectare reserve consisting of over 400 hectares of near pristine Cerrado, a patch of degraded Atlantic Forest and areas of transitional semi-deciduous, semi-humid forest. The four main Cerrado ecotopes are present at RNLB and grow on a predominately sandy substrate (Eiten 1972; 1978). The Reserve is based around an eponymously-named freshwater lake of 157 hectares which, from a geological perspective, is possibly the only true lake in Paraguay (Guyra Paraguay 2008). The RNLB was declared a Natural Reserve on 3 February 2010 for a limited period of just five years (Decreto 3893 under Articulo 26 of Protected Areas Law 352/94).

The lake is low-nutrient with a sandy bed, and bordered on two sides by tall, wet grassy vegetation. Amphibian species diversity on the lake itself appears to be low and 20 species have been collected there during intensive year-round sampling (Para La Tierra *unpublished data*). In contrast, temporary ponds that form in bushy depressions at the edge of humid forest after periods of heavy rain, have higher diversity, with 28 species recorded to date (Para La Tierra *unpublished data*).

The following specimens deposited in the Museo Nacional de Historia Natural del Paraguay (MNHNP) and Para La Tierra Biological Station collection (CZPLT) were all collected at RNLB and represent new departmental records for San Pedro according to data presented by Lavilla and Brusquetti (2010). Para La Tierra specimens were collected under permit 03/11 issued by the Secretaria del Medio Ambiente (SEAM). Higher level taxonomy follows Pyron and Wiens (2011).

HYLIDAE

Dendropsophus jimi (Napoli and Caramaschi 1999) MNHNP 11449 (16 February 2010) (Figure 1).
Dendropsophus minutus (Peters 1872) MNHNP 11455-11458 (16 February 2010) (Figure 2).
Hypsiboas albopunctatus (Spix 1824) MNHNP 11462 (17 February 2010) (Figure 3).
Scinax fuscovarius (A.Lutz 1925) MNHNP 11446 (16 February 2010) (Figure 4).

LEPTODACTYLIDAE: LEPTODACTYLINAE

Leptodactylus mystacinus (Burmeister 1861) CZPLT-H-189 (25 August 2011) (Figure 5).

Leptodactylidae: Leiuperinae
Eupemphix nattereri (Steindachner 1863) MNHNP 11441-1143 (16 February 2010) (Figure 6).
Physalaemus centralis (Bokerman 1862) MNHNP 11461 (17 February 2010) (Figure 7).
Physalaemus marmoratus (Reinhardt and Lütken 1862) MNHNP 11440 (16 February 2010) (Figure 8).

Odontophrynidae
Odontophrynus americanus (Duméril and Bibron 1841) CZPLT-H-178 (17 July 2011) (Figure 9).

Bufonidae
Rhinella scitula (Caramaschi and Niemayer 2003) CZPLT-H-253 (21 October 2011) (Figure 10).

Microhylidae
Chiasmocleis albopunctata (Boettger 1885) CZPLT-H-299 (22 November 2011) (Figure 11).

Siphonopidae
Siphonops paulensis (Boettger 1892) CZPLT-H-378 (11 April 2012) (Figure 12).

The records published herein increase the San Pedro departmental amphibian list from 24 to 36 species. Following the criteria of Lavilla and Brusquetti (2010), San Pedro is now the 7th most species-rich department in Paraguay in terms of its amphibian fauna and 43.4% of the 83 Paraguayan amphibian species present in Paraguay have now been documented to occur there. This represents an increase of 14.5% of the national list over the numbers reported for 2010 (24 species, 28.9% of national total).

The additional species reported here represent an increase of 50% in the San Pedro departmental list since Lavilla and Brusquetti (2010) in a single year of sustained field work at a single site. These numbers are remarkable as between Brusquetti and Lavilla (2006) and Lavilla and Brusquetti (2010) the mean change in the number of species per department was -1.6% (range Guairá -11.1% to Cordillera 4.2%) reflecting an almost complete lack of sampling effort in the intervening years (Table 1). In fact only three departments showed an increase in their amphibian lists during this period (Alto Paraguay 2.4%, Cordillera 4.2% and Itapúa 2.5%) whilst seven saw a decrease and seven were unchanged.

The issue of chronic under-sampling in Paraguay is highlighted by the data presented here, which is the result of sustained inventory work by Para La Tierra Biological Station, based permanently at RNLB. This year-round field effort has resulted in an amphibian list for this single small private reserve of 29 species, greater than the total published lists for seven entire political departments - Alto Paraná, Caaguazú, Caazapá, Cordillera, Guairá, Misiones and Ñeembucú - and equal to two others - Boquerón and Paraguarí. The RNLB list accounts for a total of 80.6% of the species documented for the entire department of San Pedro and 34.9% of the species recorded in Paraguay. Undoubtedly the amphibian list for RNLB will increase with further sampling, and it may be assumed that similar collecting effort in other less well-sampled Paraguayan departments will lead to comparable results in terms of their respective species lists.

The call for increased collecting and field sampling effort is frequently made but rarely heeded (Dodd and Franz1993; Goodman and Lanyon 1994; Remsen 1995; Patterson 2002; Funk *et al.* 2005). The benefits of more comprehensive field collections are well-documented (Pettit 1991; Kovacic 2009), but perhaps nowhere are these reasons more valid than in Paraguay, one of the most under-studied and under-sampled countries in South America. The results presented here confirm that our knowledge of amphibian distribution in Paraguay is seriously deficient, and this has serious consequences for the efficiency of conservation measures proposed to counteract the undesirable effects of global amphibian declines at the national level (Alford and Richards 1999; Whiles *et al.* 2006).

Though small, the importance of the RNLB for conservation in Paraguay should not be underestimated. With over 400 hectares of globally-threatened, pristine Cerrado habitat, plus an artesian lake arising from the Guarani Aquifer, the reserve is of both national and international importance. It was declared an Important Bird Area by Birdlife International (IBA PY021- Guyra Paraguay 2008) due to the extraordinarily high number of globally (11) and nationally (47) threatened bird species occurring within the reserve. Early indications from ongoing herpetological inventories suggest that it is also an area of national and international importance for the conservation of reptiles and amphibians. Consolidating the long term conservation of the RNLB should be a national conservation priority.

Figure 1. *Dendropsophus jimi* (Paul Smith).

Figure 2. *Dendropsophus minutus* (Helen Pheasey).

Figure 3. *Hypsiboas albopunctatus* (Helen Pheasey).

Figure 4. *Scinax fuscovarius* (Helen Pheasey).

Figure 5. *Leptodactylus mystacinus* (Helen Pheasey).

Figure 6. *Eupemphix nattereri* (Paul Smith).

Figure 7. *Physalaemus centralis* (Helen Pheasey).

Figure 8. *Physalaemus marmoratus* (Helen Pheasey).

Figure 9. *Odontophrynus americanus* (Paul Smith).

Figure 10. *Rhinella scitula* (Helen Pheasey).

Figure 11. *Chiasmocleis albopunctata* (JP Brouard).

Figure 12. *Siphonops paulensis* (Helen Pheasey).

Table 1. Numbers of amphibian species recorded per Paraguayan department according to previously published sources. The figures in brackets in the columns Brusquetti and Lavilla (2006) and Lavilla and Brusquetti (2010) represent the departamental "ranking". The fourth column shows the departmental amphibian faunal lists represented as a percentage of the total national list according to Lavilla and Brusquetti (2010). The fifth column is the percentage change in the individual departmental lists between 2006 and 2010.

Paraguayan Department	Brusquetti and Lavilla (2006)	Lavilla and Brusquetti (2010)	Percentage of national list	Percentage change 2006-2010
Alto Paraguay	41 (3rd)	42 (2nd)	50.6%	2.4%
Alto Paraná	21 (14th)	21 (14th)	25.3%	0%
Amambay	38 (5th)	37 (5th=)	44.6%	-2.6%
Boquerón	30 (8th=)	29 (8th=)	34.9%	-3.3%
Caaguazú	24 (12th=)	24 (12th=)	28.9%	0%
Caazapá	19 (16th)	19 (16th)	22.9%	0%
Canindeyú	35 (7th)	35 (7th)	42.2%	0%
Central	37 (6th)	37 (5th=)	44.6%	0%
Concepción	44 (1st=)	40 (4th)	48.2%	-9.1%
Cordillera	24 (12th=)	25 (11th)	30.1%	4.2%
Guairá	18 (17th)	16 (17th)	19.3%	-11.1%
Itapúa	40 (4th)	41 (3rd)	49.4%	2.5%
Misiones	27 (10th)	26 (10th)	31.3%	-3.7%
Ñeembucú	20 (15th)	20 (15th)	24.1%	0%
Paraguarí	29 (9th)	29 (8th=)	34.9%	0%
Presidente Hayes	44 (1st=)	43 (1st)	51.8%	-2.3%
San Pedro	25 (11th)	24 (12th=) (including this publication 36, 7th)	28.9% (including this publication 43.4%)	-4% (including this publication 44%)
Paraguay Total	81	83	Mean 36% (including this publication 36.9%)	Mean -1.6% (including this publication +1.2%)

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